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Rock Island Arsenal Laboratory

TECHNICAL REPORT

TRANSPARENT SKIN AND BLISTER PACKAGING

By

R. L. Murrens

Department of the Army Project No. 593-32-007

Ordnance Management Structure Code No. 5010.11.84200.51

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ABSTRACT

Transparent skin and blister packages enclosing steel panels and various small items were fabricated by vacuum forming and electronic sealing equipment and submitted to various laboratory accelerated tests for evaluation. The results of these tests indicated that a polyester/polyethylene laminate as a skin packaging material would provide level A protection. Both vinyl and cellulose acetate butyrate have excellent clarity and qualities for fabrication with automatic vacuum forming and electronic sealing equipment. These materials have limited use. When formed into blisters and subjected to low temperature and high humidity tests, the blisters exhibited embrittlement, cracking, and swelling.

CONCLUSIONS AND RECOMMENDATIONS

Based on the results of tests conducted, it is concluded that the transparent polyester/polyethylene laminate is satisfactory for use as skin packaging material and as a unit barrier for level A protection. It is recommended that this material be considered for applications in Ordnance packaging.

Vinyl and cellulose acetate butyrate are satisfactory as blister packaging materials and are recommended for applications in Ordnance packaging, except for packs that will encounter temperature lower than -35F.

It was concluded that plain uncoated polyethylene in thicknesses ranging from 0.010 inch to 0.030 inch exhibited fabrication difficulties, especially in sealing. Polyethylene is not recommended for applications in Ordnance packaging where skin and blister methods are used.

TRANSPARENT SKIN AND BLISTER PACKAGING

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TRANSPARENT SKIN AND BLISTER PACKAGING

OBJECT

To evaluate transparent plastic films utilizing blister and skin packaging techniques as a means of providing adequate protection and ready identification for Ordnance items.

INTRODUCTION

In order to insure that military items in storage are in ready-for-issue condition, it is necessary to conduct periodic inspections. When opaque unit barriers are used, depackaging and repackaging are necessary with each inspection, and the cost of the original package may be multiplied many times. If transparent thermoplastic materials are used as unit barrier materials, the expense of periodic inspections will be less as the condition of the items can be observed through the barrier. In addition to this "see-through inspection" factor, many other advantages are possible, as thermoplastic materials are adaptable to blister and skin packaging techniques.

It was decided to evaluate blister and skin packs in laboratory accelerated tests to determine the protection afforded by various transparent barriers and their durability after being heated and stretched under pressure. As a starting point, a literature search was conducted and plastic barriers were chosen which appeared to have the qualities needed for a level A military package. A vacuum forming machine, an electronic sealer and a bar heat sealer were purchased.

After a preliminary testing period, in which the various barriers were fabricated into packs with the equipment, the following materials were chosen which appeared to give the best performance and show the most promise for military purposes: (1) cellulose acetate butyrate, (2) polyethylene, (3) polyvinyl chloride, (4) polyester, (5) polyester/polyethylene.

Historically, the forming of sheet plastics under heat and pressure had its beginnings in the late thirties, and important progress followed with techniques developed during the Second World War for forming contour maps. Then during the fifties, thermoforming began its rapid climb into the field of packaging.

The term "skin pack" refers to a package unit where a thermoplastic film has been formed directly over the item to

a backing board by heat and pressure. The term "blister" refers to a simple curved or angular shape of thermoplastic not conforming to the shape of the item. The "contour" pack differs from the "blister" in that the "contour" conforms to the shape of the item. Blister and contour packs use semi-rigid thermoplastic, while skin packs use flexible film.

Vacuum forming equipment ranges in complexity from simple laboratory type hand pump models selling for one hundred dollars or less to regular production line models in the range of one to several thousand dollars and then up to specialized automatic push button type machines that sell for ten thousand dollars and higher. Among recent developments are machines that do a complete forming and packaging job. Machines of this type are now employed in the packaging of thread, spark plugs and razor blades. Vacuum machines are available in sheet and roll fed models.

In skin packaging operations the items to be skin packaged are placed on a mounting board. The items are positioned uniformily by means of a template, and the board is placed on a screen support above the vacuum area of the machine. Thermoplastic film is placed securely in a movable frame suspended above the items to be packaged. Heaters are then brought over the film. As the film becomes soft and pliable from the heat, it is lowered and a vacuum beneath the board causes atmospheric pressure to force the film into a skin tight engagement with the items and the board. The paperboard portion of the package is usually coated with a heat responsive material which seals it to the hot film. when the inner surface of the film is polyethylene, the polyethylene will adhere to most paperboard surfaces without the need of special board coatings.

Electronic sealing is accomplished by sending a high frequency current through two or more layers of thermoplastic material placed between two (unheated) sealing electrodes or dies. These shaped bars can perform both the sealing and the cutting function. The dies are usually mounted in a pneumatic or hydraulic press to provide pressure for fusing the material. The seal is accomplished when high frequency electric current heats and liquefies the material and the pressure exerted brings a thorough fusion. Pressure is used to assure intimate contact of the interfaces and time is employed to bring the interface to sealing temperature which is the welding temperature or temperature at which the interface disappears. These three variables all have upper limits. Temperature is limited by damage to the material. Pressure is limited by thinning of the seals and time is limited because of production objectives.

GENERAL PROCEDURE

Tests were conducted to evaluate the performance of skin and blister packs in various environments. All environments were produced by laboratory equipment. The following environments were used for test purposes: (a) high temperature 165 F, (b) low temperature -65 F, (c) a combination of high temperature and high humidity (120 F at 98 to 100% R.H.), (d) a combination of high temperature 165 F (oven) and fresh water immersion at room temperature, (e) a combination of low temperature -65 F and high humidity of 95% R.H. at 95-100 F, and (f) cyclic exposure test A of MIL-P-116*. These test environments would determine the effectiveness of heat seals to remain intact and the ability of skin and blister barriers to protect steel panels after undergoing distortion caused by heat and pressure in the vacuum former. Items used in the skin and blister test packs consisted of steel panels and miscellaneous electronic parts including vacuum tubes.

The steel panels acted as corrosion indicators and the electronic parts represented basic examples of irregular forms for blister packs. Packs containing vacuum tubes were not placed in environmental tests. Each steel panel (2" wide by 3" long by 1/8" thick) weighed approximately 3 ounces and was prepared with one sandblasted surface and one polished surface. All panels were from the same type of steel (1020). Prior to packaging, the panels were cleaned and dried in accordance with the cleanliness criteria specified in MIL-P-116, but generally only normal precautions were observed. Sheet and roll type stock was used immediately after it was cut or removed from a roll or stack of sheets. The inclusion of VCI in the packs was accomplished in accordance with paragraph 3.6 of MIL-I-8574. One tenth gram and one gram quantities were used. For assurance of closure, all packs were leak tested according to MIL-P-116 paragraph 4.4.3 prior to the start of the test.

Steel panels were also placed in pouches fabricated from MIL-B-131 and MIL-B-121 materials for purposes of comparison. No rough handling or storage aging tests were conducted.

PROCEDURE AND RESULTS

A Blister Pack - Test A

(1) Method of Test

Packs 1 through 4 consisted of opaque barriers. It was necessary to cut open the pack in order to inspect the panel.

*See Appendix

One pack was scheduled for opening and inspection after every 7th day. The test exposure of packs 1, 2, 3 and 4 was completed after six weeks. Packs 5 through 10 consisted of transparent barriers, and the condition of the steel panels inside was evaluated by observation through the barrier after every 7th day. The transparent packs were not opened until after the completion of the test period of 182 days.

Each pack contained 6 (2" by 3" by 1/8") steel panels sealed separately and spaced equally from each other. The heat seals were 1/2" wide and were made on the heated bar type sealer. Embossed aluminum tags were also sealed inside the packs for identification purposes.

The MIL-B-121 and MIL-B-131 materials were sealed at a temperature of 425 F, 2 seconds dwell and a pressure of 30 psi. The vinyl was sealed at 300 F, 2 seconds dwell and a pressure of 26 psi. The barrier material, its thickness and preservation method used for each transparent pack, are listed in Table I, column 2. Vapor corrosion inhibitor in 1/10th gram quantities was placed inside half of the packs just prior to making the final seal. All packs were leak tested prior to the start of the test.

(2) Results

A summary of the results is presented in Table I. A panel enclosed in MIL-G-121 material without VCI showed light rust after one week of exposure. No rust was observed on any panel enclosed in MIL-G-121 with VCI until after the 5th week of exposure when the 6th panel was examined.

No rust was observed on panels enclosed in MIL-B-131 material without VCI until after the 5th week when the 6th panel displayed rust. The panels enclosed in MIL-B-131 with VCI showed the same results when the 6th panel after the 5th week showed rust.

Panels enclosed in polyester material (0.005 inch thick) without VCI showed incipient rust after 7 days of exposure. A special tape* for sealing polyester film was used to seal this material to itself. At the final inspection after 182 days, the total rust accumulation on each panel averaged from 10 to 25%. Rust was not observed on panels enclosed in polyester (0.005 inch thick) with VCI until after 119 days of exposure. The final inspection after 182 days revealed two panels nearly rust free, each showing a rust accumulation

*See Code Sheet, No. 7

TABLE I

HUMIDITY TEST OF TRANSPARENT AND OPAQUE BARRIERS, CONDUCTED AT 100F AND 95±2% R.H.

Test No.	Barrier Material and Preservation Method	Results
1	MIL-B-121 No preservative	Light rust was observed on 1 panel after 7 days.
2	MIL-B-121 with 0.1 gm. VCI	No rust appeared on any panel until after 35 days.
3	MIL-B-131 No preservative	Same as 2.
4	MIL-B-131 with 0.1 gm. VCI	Same as 2 and 3.
5	Uncoated poly-ester .005 No preservative	Incipient rust was observed on all panels after 7 days.
6	Uncoated poly-ester .005 with 0.1 gm. VCI	Incipient rust was observed after 119 days. Two panels exhibited less than 1% rust after 182 days.
7	Vinyl .010 No preservative	Incipient rust on all panels after 7 days. Each panel exhibited 10-25% rust after 182 days.
8	Vinyl .010 with 0.1 gm. VCI	Incipient rust on 2 panels after 7 days. After 182 days panels 3 and 6 showed 1% rust. After 182 days panels 1, 2 & 4 showed 2% rust. After 182 days panel 5 showed 10% rust.

of less than 1%. The other 4 panels were disqualified for the final inspection as they became mixed when seam separations occurred after 172 days.

All 6 panels enclosed in vinyl (0.010 inch thick) without VCI showed rust after 7 days in exposure. At the final inspection after 182 days, each panel showed approximately 10-25% rust accumulation.

Two panels enclosed in vinyl (0.010 inch thick) with VCI showed 1-5% rust on each of their surfaces after the first 7 days of exposure. There was no further noticeable increase in rust on these panels during the remainder of the test period. At the final inspection after 182 days, the rust accumulation on each of the 6 panels ranged from one-half of 1% to 10%. The polished sides of the panels exhibited slightly less rust than the sandblasted side. Panels 1 and 2 each showed less than 1% on the polished sides. The sandblasted sides of each exhibited less than 2% scattered light rust dots. The polished sides of panels 3 and 6 both showed single rust dots representing less than one-half of 1% rust accumulation. The sandblasted side of panel 3 showed 5% while the sandblasted side of panel 6 showed less than 5%. The polished sides of panels 4 and 5 showed 5% rust coverage. The sandblasted side of panel 4 showed 5-10% coverage. Panel 5 displayed a heavy rust spot representing less than 2% rust accumulation on its sandblasted side.

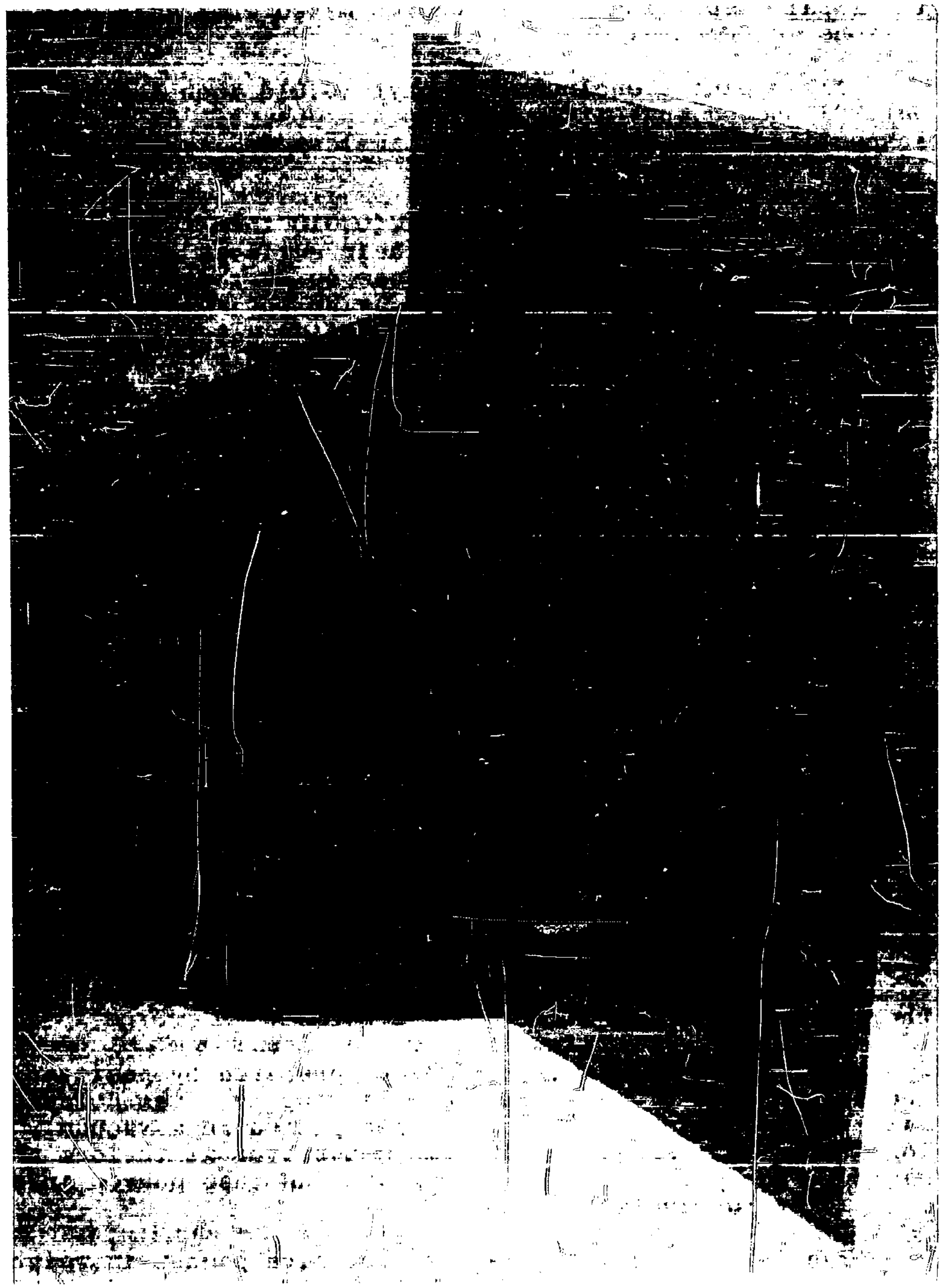
B Blister Pack - Test B

(1) Method of Test

All packs were fabricated from (0.020 inch thick) vinyl. See Figure 1. The contours were formed by heat and vacuum on a vacuum forming machine. Plaster-of-Paris molds were used. The items were enclosed by sealing a flat sheet of (0.020 inch thick) vinyl to the flanges of the contour with the electronic sealer.

The plaster-of-Paris molds were prepared by positioning the item on its broadest base and masking the item downward with tape. The masked item was then placed in a vacuum former and thin gauge plastic was drawn over it to form a cavity. The plaster-of-Paris mixture was then poured into the cavity forming a mold.

The items selected were not over five pounds in weight. No preservatives were used. Moisture indicator cards were placed in each pack.



VINYL BLISTER - 4 INCH DRAW DEPTH

FIGURE 1

Neg.No. 3808
62-3600

The .020 inch thick vinyl was sealed electronically using a filament voltage of 7, a dwell time of 8-9 seconds, an amperage of 20, and a die pressure of 75 psi. See Figure 2. The sealed packs were leak tested prior to their placement in test.

(2) Results

A summary of results is presented in Table II.

After 30 consecutive days of humidity and low temperature cycle exposure test, good clarity was maintained by each pack and no seam trouble developed. Swelling occurred in approximately 50% of the packs and stress cracks occurred on two blisters. See Figure 3. Cracks developed along the inside edge of the seam in 2 packs. Small areas of condensation were observed, both on the inner side of the barriers and on the enclosed items of all packs remaining in the test for 30 days. All ferrous parts of items remaining in test for 30 days displayed light to medium rust. The chemical in the indicator cards was leached in all packs completing 30 days. Although corrosion data were obtained, the test was not conducted for this purpose, but to evaluate the performance of blisters after maximum draw in the vacuum former. Results showed that electronic heat seals were satisfactory, but need for preservation inside blisters and need for forming materials resistant to swelling and cracking was apparent.

C Blister Pack - Test C

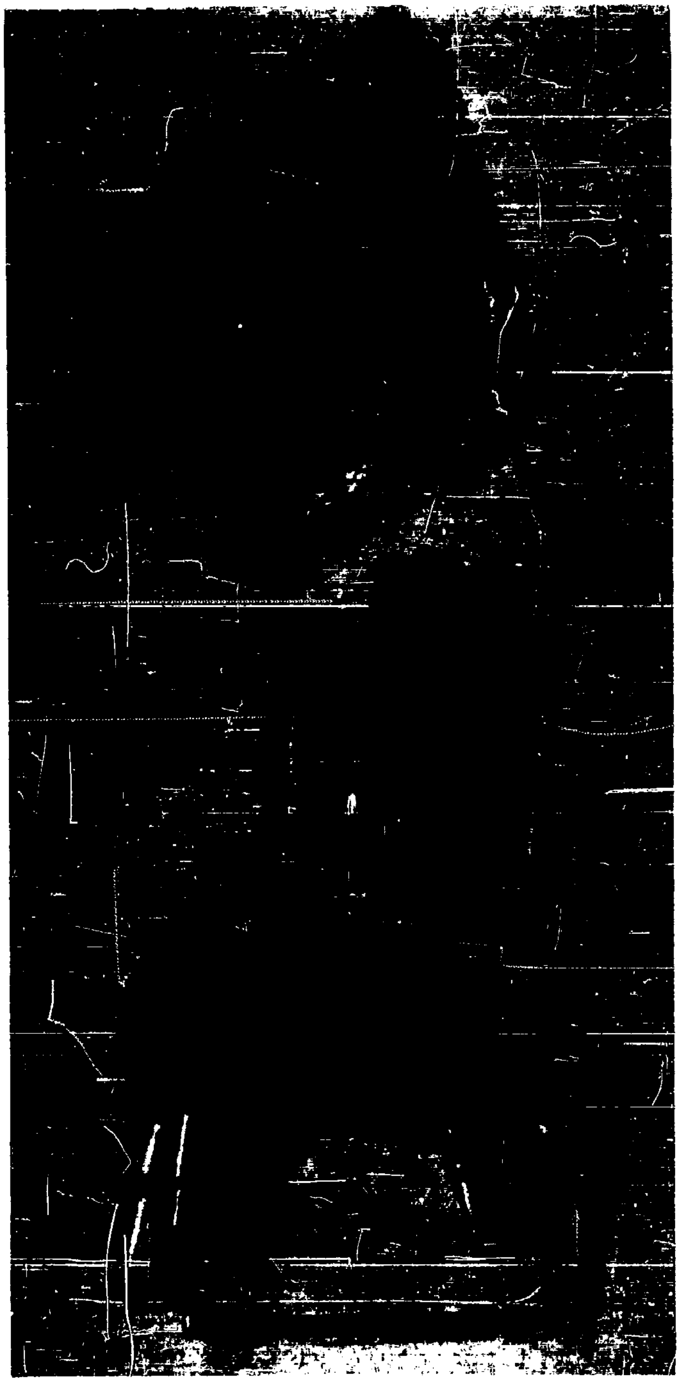
(1) Method of Test

Ten sheets of specimens were prepared. Each sheet consisted of 9 cavities. Each cavity contained one ball bearing. See Figure 4. Seven of the 9 bearings were coated with preservatives. Two remained unpreserved as controls. The barrier materials and preservatives are listed in Table III. The location of the preservative in relation to the position of the cavity on the sheet was randomized on each of the 10 sheets.

The cavities were formed in the vacuum former. The polyethylene was sealed with the heated bar sealer, and the acetate sheets were sealed with the electronic sealer.

The following test procedure was used in sequence:

a. Static low temperature at -35F for 48 consecutive hours.



VINYL BLISTER PACKS - READY FOR TESTING

FIGURE 2

Neg.No. 3809
62-3600

TABLE II

HUMIDITY AND LOW TEMPERATURE TEST* - VINYL BLISTER PACKS

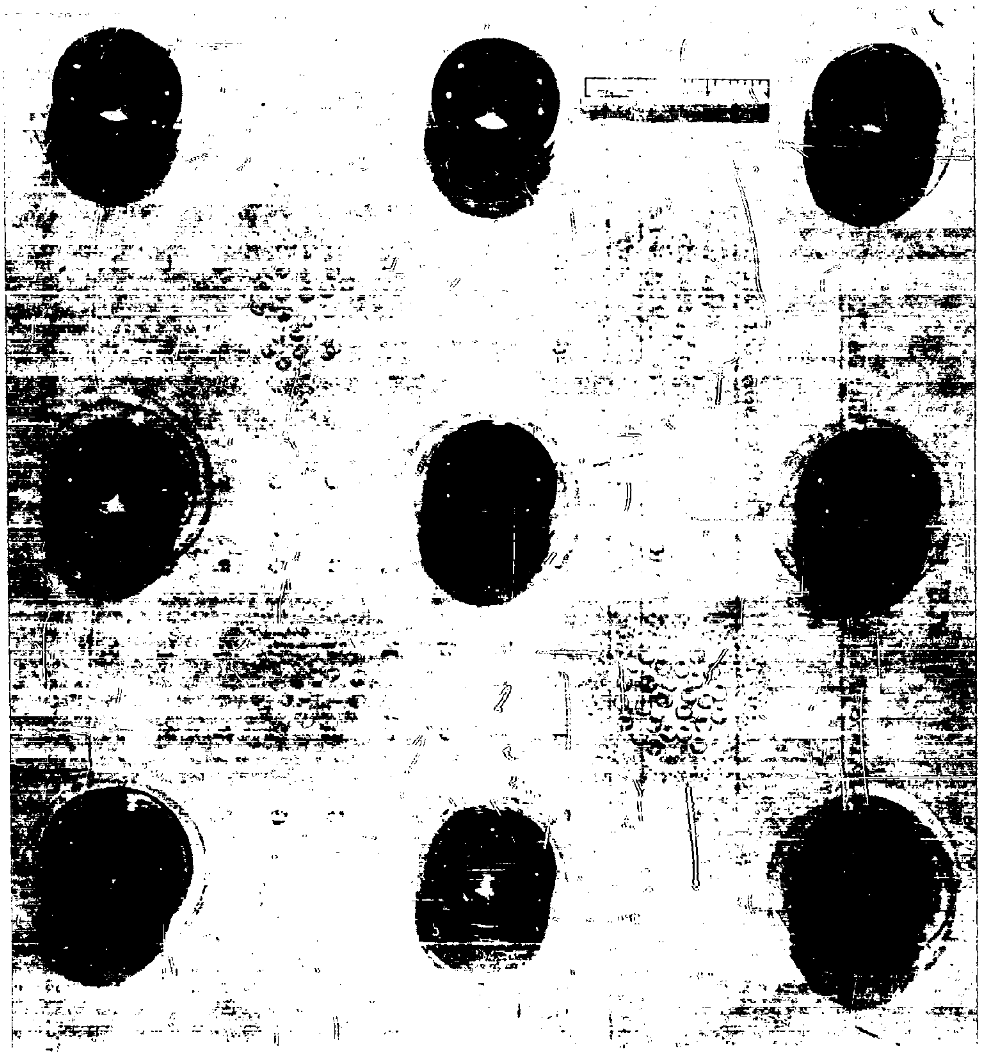
ITEM NO.	ITEM	DURATION OF TEST (DAYS)	CORROSION	CONDENSATION ON INSIDE OF BARRIER	CONDITION OF BARRIER	SWELLING	COMMENTS
1	Vacuum tube	30	None	Yes	Good	None	All surfaces plated or glass.
2	Handle	30	Light-med.	Yes	Good	None	The paint coating was flaky.
3	Output transformer	30	Light	Yes	Good	None	The corrosion occurred only on the threads.
4	Fuel pump	30	Light	Yes	Good	Slight	Corrosion occurred only in uncoated surface areas.
5	Switch Assy. X-14	30	Light	Yes	Good	Medium	Corrosion occurred on unplated screw heads.
6	Carburetor	30	Light-med.	Yes	Good	Heavy	Heavy swelling occurred at bottom where weight of item rests.
7	Armature	30	Light-med.	Yes	Good	Heavy	Corrosion occurred on ferrous surfaces.
8	Multiple Switch Assy.	30	Light	Yes	Good	Heavy	Pronounced swelling occurred at the bottom.
9	Gear	30	None	No	Split at seam	Medium	All aluminum barrier near seam (inside) developed 1 inch split.
10	Transformer	8	None	No	Split	None	Removed from test when crack in barrier appeared.
1	Condenser	14	None	No	Split	None	Removed from test when crack in barrier appeared.
12	Servo Motor	14	None	No	Split at seam	Slight	Removed from test when split near seam occurred.
Control	Steel Panel	30	Light	On Panel	Good	Heavy	Both sides of each panel showed light rust spots.

*Low temperature at -65F for 8 hours alternated by humidity exposure at 120F and 95±2% R.H. for 16 hours.

VINYL BLISTER PACKS AFTER TESTING (NOTE SWELLING)

FIGURE 3

Neg.No. 3807
62-3600



ACETATE MULTIPACK - READY FOR TESTING

FIGURE 4

Neg. No. 1182
62-3600

TABLE III

CYCLIC EXPOSURE TEST* - BLISTER PACKS

		Thickness in Mils									
		Polyethylene					Cellulose Acetate Butyrate			Cellulose Acetate	
No.	Preservative	15	20	30	50	60	15	20	30	15	20
1	MIL-C-16173, Gr. 3	F	F	F	F	F	G	G	G	G	G
2	MIL-L-644	F	F	F	F	G	G	G	F	G	G
3	MIL-G-3278	G	G	G	G	F	F	F	G	G	G
4	MIL-G-10924	G	G	F	F	F	G	G	F	G	G
5	MIL-L-6085	G	G	G	G	G	G	G	G	G	G
6	VCI	G	G	G	G	G	G	G	G	G	G
7	G-65 Emulsifiable	F	F	F	F	F	F	G	F	F	G
8	Control	F	F	G	G	F	F	G	F	F	F
9	Control	F	F	F	F	F	G	F	F	F	G

F = visible corrosion observed after completion of 30-day test.

G = no failures observed.

*Low temperature at -35F followed by water immersion at room temperature, then Cyclic Exposure Test A of MIL-P-116, and humidity exposure at 100F and 95±2% R.H.

b. Fresh water immersion at room temperature for 48 consecutive hours. After withdrawal - room temperature for 72 consecutive hours.

c. Cyclic exposure, MIL-P-116 test A. After withdrawal - room temperature for 72 consecutive hours.

d. Humidity cabinet static storage at 100F and 95-100% R.H. for 720 consecutive hours.

(2) Results

The results of the cyclic exposure tests are summarized and presented in Table III. The results are based upon observations conducted immediately after the test and once again after the blisters were opened.

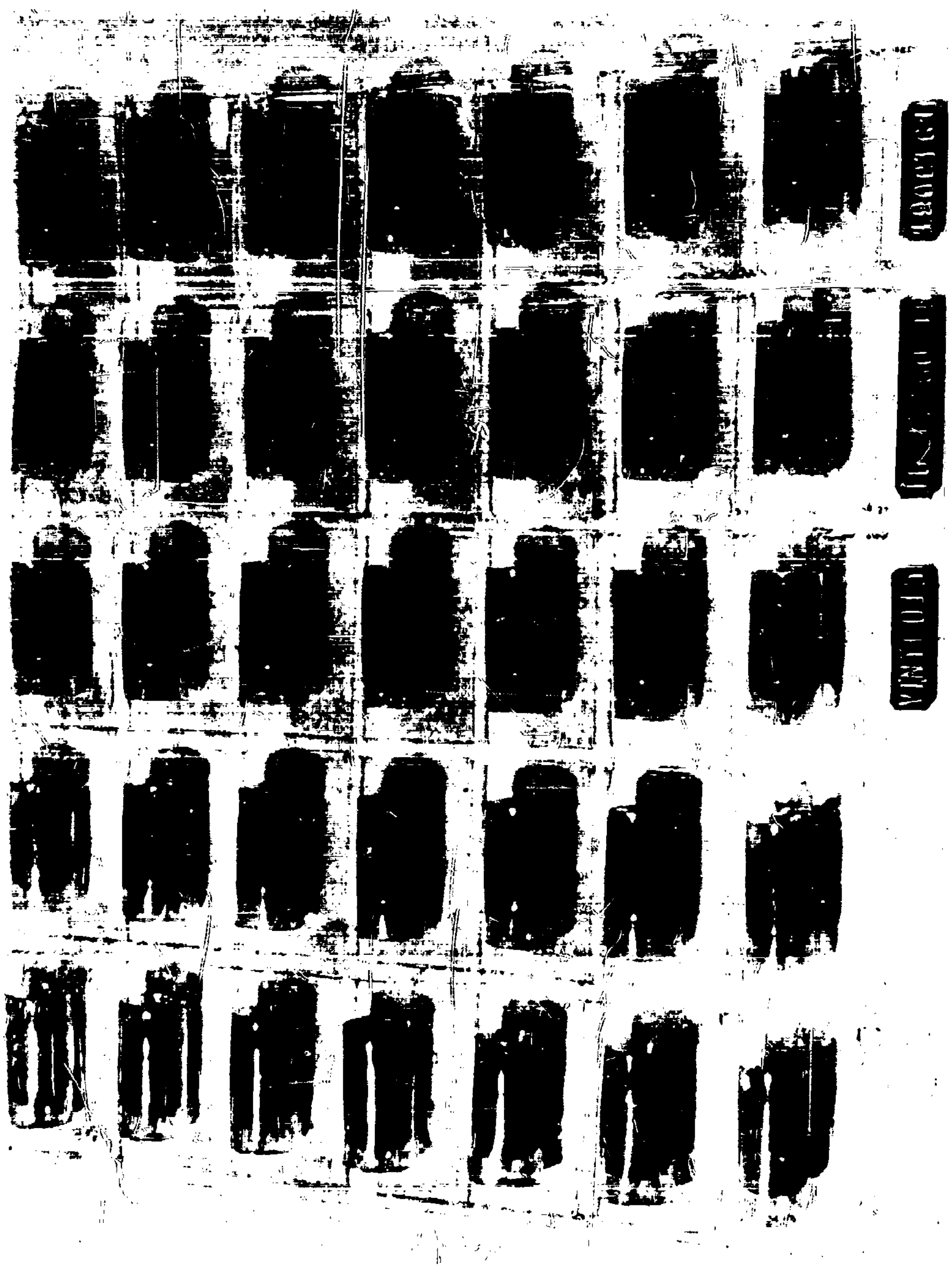
The controls (no preservative) performed as expected. Nearly all bearings with no preservation exhibited corrosion. The G-65 emulsifiable rust preventive performed in similar manner. MIL-C-16173, Grade 3 provided corrosion free protection only to bearings sealed inside cellulose acetate and cellulose acetate butyrate blisters. MIL-G-3278 and MIL-G-10924 provided corrosion protection to approximately 60% of the items regardless of barrier material. MIL-L-6085 and VCI coated kraft provided corrosion protection to all bearings during the test. MIL-L-644, MIL-G-3278, and MIL-G-10924 provided corrosion protection only to bearings sealed inside cellulose acetate blisters.

D Blister Pack - Test D

(1) Method of Preparation

A multipack,enclosing glass vacuum tubes, was fabricated from (0.015 inch thick) vinyl. See Figure 5. The multipack barrier consisted of a molded sheet and a plain flat sheet. In forming the pack, the molded sheet and the flat sheet were sealed on the high frequency sealing press.

In preparation for vacuum forming, each vacuum tube was enclosed by a small sheet of (0.005 inch thick) polyester material wrapped around the tube to form a heat resistant sleeve. The items were next placed upon a plain sheet of (0.010 inch thick) Bristol board whose length and width dimensions were trimmed to fit the vacuum former. The Bristol board sheet was marked into rectangular areas of equal spacing between items to facilitate proper forming and sealing. The



VINYL BLISTER MULTIPACK

FIGURE 5

Neg.No. 3805
62-3600

items were fixed to positions on the board with rubber adhesive to prevent any shifting which might occur during the forming cycle.

During the actual forming a (0.020 inch thick) vinyl sheet was heated to forming temperature and lowered over the items where vacuum was applied. This caused a conformance and partial enclosure of each item leaving only a small narrow opening directly below each item.

The contoured sheet with the partially enclosed items was then sealed to a flat sheet on the electronic sealer. Seals were made parallel with the long axis of the vacuum tubes. Eight seals were completed with 12-15 seconds dwell at 60 pounds pressure and 17 amps. Thirty-five items were then isolated or unitized by 14 seals. The multipack was fabricated from 2 vinyl sheets of similar thickness (0.020 inch), however, a backing sheet of (0.010 inch thick) vinyl has been found to seal successfully to the contoured sheet of (0.015 inch thick) vinyl. Attempts to seal a flat sheet of (0.010 inch thick) vinyl to (0.010 inch thick) vinyl molded sheet were not successful. Thin areas were produced in the vacuum drawn sheet which caused arcing during the electronic sealing operation.

Attempts to use filter paper as a base upon which the items could be placed for vacuum draw were not successful. Although the nature of the paper allowed for maximum draw and distribution of force, a pebble grain impression was formed on the flat surfaces of the formed sheet. These rough surfaces would not produce as effective a heat seal as a flat smooth surface.

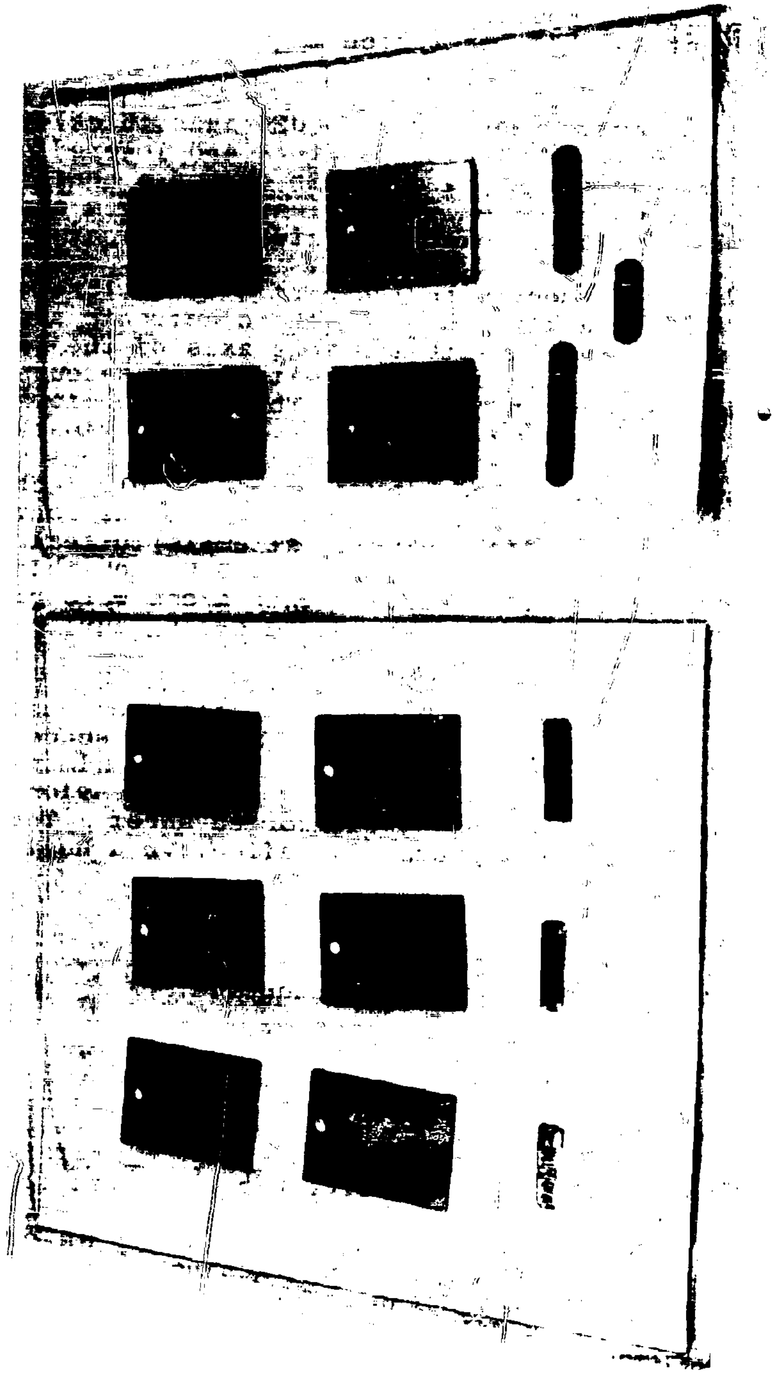
(2) Results

No environmental tests were conducted.

E Skin Pack - Test E

(1) Method of Test

All packs were made from polyester/polyethylene laminates of 3 thicknesses: 0.003 inch, 0.0025 inch, and 0.001 inch. Steel panels were skin packed to (0.010 inch thick) Bristol board on the vacuum forming machine. The laminated board containing the steel panels was trimmed so that a 1/2 inch border of plastic film remained around the edge of the board. See Figure 6. The border strip was then sealed to itself on three sides after the board was folded. The closure



SKIN PACKS - READY FOR TESTING

FIGURE 6

Neg.No. 3806
62-3600

of the unfolded type pack was made by sealing the same material to the border of all 4 sides. The seals were accomplished on a heated bar sealer at 2 seconds dwell, 220F. and 40 pounds pressure. The packs were then placed in a cyclic exposure test: oven temperature at 165F. for 8 hours and fresh water immersion at ambient temperature for 16 hours. On weekends the test packs remained in the fresh water immersion tank.

(2) Results

The polyester/polyethylene laminate adhered firmly to uncoated and unperforated (0.010 inch thick) Bristol board. The polyethylene component fused effectively to itself when the board was sandwiched between the 2 film laminates. However, due to heat resistance, the polyester component does not permit a complete vacuum draw or full conformance to the contours of the part.

TABLE IV

OVEN AND WATER IMMERSION TEST* - SKIN PACKS

Test No.	Barrier Material Thickness and Pres. Method	Results
1	Polyester/polyethylene 0.003, no VCI, not folded	No rust on any panel after 22 weeks.
2	Polyester/polyethylene 0.003, with VCI, not folded	No rust on any panel after 22 weeks.
3	Polyester/polyethylene 0.003, with VCI, folded	No rust on any panel after 22 weeks.
4	Polyester/polyethylene 0.0025, with VCI, not folded	No rust on any panel after 22 weeks.
5	Polyester/polyethylene 0.003, no VCI, folded	Light rust area appeared on one panel after 17th week, no significant increase since.
6	Polyester/polyethylene 0.001, no VCI, folded	Very light rust evenly dispersed over three of four panels appeared after 22 wks.

*Oven temperature at 165F (for 8 hrs.) alternated by immersion in fresh water (for 16 hrs.) at ambient temperature for 22 weeks.

DISCUSSION

The vacuum tube multipack (Figure 5) incorporates some of the important features of a transparent package: Transparency for ease in identification and inventory, and immobility of item to minimize shock and vibration. The design of the multipack provides for equal spacing and distribution of weight. Stacking and packing procedures are facilitated. One item may be removed from the multipack sheet as a complete unit without contaminating other items or the item removed. The detached pack can remain intact until it is necessary to remove the item. Also, changes in sizes of intermediate containers and shipping containers may be accomplished without changing the design of the unit pack.

To simulate conditions that would be normal in practice, no exceptional precautions were taken to control the atmosphere of the processing area during packaging. Panel surfaces were exposed to a nondust free atmosphere for a brief time during processing.

In electronic sealing, the sealing jaws or electrodes remain unheated and the fusion of the thermoplastic takes place when an electric field penetrates the material instantly and thoroughly. Jaw pressure can be held to a minimum, thus preventing thinning and extrusion. It is possible to recognize incompletely fused areas during sealing, as these areas will show up as slightly opaque when compared to the clearer transparency of an adequate seal.

APPENDIX

Cyclic Exposure, Test A - MIL-P-116

Overnight at 120 F. to 130 F.
Two hours of water spray at 50 F. to 60 F.
Two hours at -10 F. to 0 F.
Two hours of water spray at 120 F. to 130 F.
Two hours of water spray at 50 F. to 60 F.
Overnight at 35 F. to 50 F.

Four hours at 120 F. to 130 F.
Two hours of water spray at 50 F. to 60 F.
Two hours at 35 F. to 50 F.
Overnight at 120 F. to 130 F.

Two hours of water spray at 50 F. to 60 F.
Two hours at -10 F. to 0 F.
Three hours at 35 F. to 50 F.
Overnight at 120 F. to 130 F.

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Rock Island Arsenal Laboratory, Rock Island, Illinois
TRANSPARENT SKIN AND BLISTER PACKAGING
by R. L. Murrens

RIA Lab. Rep. 62-3600, 31 Oct 62, 27 p. incl. illus. tables, (DA Project No. 593-32-007, OMS Code No. 5010.11.84200.51) Unclassified report.

Transparent skin and blister packages enclosing steel panels and various small items were fabricated by vacuum forming and electronic sealing equipment and submitted to various laboratory accelerated tests for evaluation. The results of these tests indicated that a polyester/polyethylene laminate as a skin packaging material would provide level A protection. Both vinyl and cellulose acetate butyrate have excellent clarity and qualities for fabrication with automatic vacuum forming and electronic sealing equipment. These materials have limited use. When formed into blisters and subjected to low temperature and high humidity tests, the blisters exhibited embrittlement, cracking, and swelling.

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